Original Article

Evaluation of mandibular transverse widths in patients affected by unilateral and bilateral cleft lip and palate using cone beam computed tomography

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ABSTRACT

Objective: To evaluate the mandibular dental, alveolar, and skeletal transversal widths in patients affected by unilateral (UCLP) and bilateral (BCLP) cleft lip and palate and to compare the findings with a well-matched normal occlusion sample using cone beam computed tomography images.

Materials and Methods: The study sample consisted of 75 patients divided into three groups: the UCLP (29 patients; mean age: 15.40 $\pm$ 3.22 years), BCLP (18 patients; mean age: 15.54 $\pm$ 3.72 years), and normal occlusion (28 patients; mean age: 15.82 $\pm$ 2.11 years) groups. Mandibular dental (intercanine and -molar), alveolar (intercanine and -molar), and skeletal (bigonial width) transversal measurements were performed three-dimensionally and analyzed using the one-way variance analysis and post hoc Tukey tests.

Results: Patients affected by UCLP and BCLP had statistically significantly lower intercanine alveolar widths ($P < .05$ and $P < .001$, respectively) and larger intermolar ($P < .001$ and $P < .05$, respectively) and intermolar alveolar widths ($P < .001$) compared with the normal occlusion group. Furthermore, the patients affected by UCLP and BCLP had similar mandibular dental, alveolar, and skeletal transversal widths ($P > .05$).

Conclusion: The UCLP and BCLP groups showed statistically significantly smaller values for intercanine alveolar widths and larger values for intermolar dental and alveolar widths compared with the normal occlusion group. This shows the importance of using individualized archwires according to the pretreatment arch widths of the patients affected by UCLP and/or BCLP. (*Angle Orthod.* 2015;85:611–615.)

KEY WORDS: Transversal width; Cleft; Cone beam computed tomography

INTRODUCTION

Cleft lip and palate (CLP) is one of the most common congenital craniofacial anomalies, and its etiology is related to genetic heritage or environmental factors.[1] High incidence rates of this anomaly were reported for Asian populations (0.079%–0.374%), intermediate rates for whites (0.091%–0.269%), and low rates for the African populations (0.018%–0.167%).[2]

CLP usually leads to various functional disturbances, including problems with feeding, hearing, speech, respiratory system, and dentofacial development[3–6]; thus, its treatment requires a multidisciplinary team approach with good interaction between different specialties such as speech therapy, otolaryngology, psychology, audiology, pedodontics, orthodontics, prosthodontics, and plastic and maxillofacial surgery.[7]

Previous studies have shown that patients affected by CLP usually have anterior and posterior crossbite, midface deficiency with a tendency toward a Class III malocclusion, increased vertical dimensions, and decreased pharyngeal airway volume.[3,5,8,9] However, studies investigating the effects of CLP on mandibular arch are limited in number; most studies[10–14] were performed using plaster models, and only a few[15,16] used the frontal radiographs of the patients. In a recent study, Ye et al.[13] evaluated mandibular dental arch morphology in unoperated and operated adult patients

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Table 1. Reasons for Cone Beam Computed Tomography Scanning

	Number of Patients
Cleft groups	
Cleft presence (orthodontic/orthognathic surgery planning, airway assessment)	47
Control group	
Temporomandibular joint assessment	16
Pharyngeal airway assessment	7
Impacted tooth localization (maxillary canine and third molar and mandibular third molar)	5

with unilateral CLP (UCLP) using computed tomography (CT) scanning of the patients' plaster models. They showed that the unoperated group had an increased mandibular posterior arch widths compared with the controls.

To the best of our knowledge, no published study was found that assessed the mandibular dental, alveolar, and skeletal transversal widths in groups of UCLP and bilateral CLP (BCLP) patients compared with a normal occlusion sample without any cleft using cone beam CT (CBCT). In addition, the UCLP and BCLP groups were not compared previously regarding the mandibular transversal widths. Therefore, the aim of the present study was to evaluate the mandibular dental, alveolar, and skeletal transversal widths in both UCLP and BCLP groups and compare the findings with a well-matched normal occlusion sample without cleft using the CBCT images.

MATERIALS AND METHODS

CBCT images used in the present study were retrospectively selected from the diagnostic records collected due to dental/orthodontic treatment need at the Department of Oral and Maxillofacial Radiology at Erciyes University. The patients and/or patients' parents had signed an informed consent form allowing the authors to use their data for scientific purposes, and the study was approved by the local ethical committee of Erciyes University. None of the patients was contacted or CBCT taken for the purpose of the present study. The reasons for which CBCT had been previously taken are shown in Table 1.

Study sample calculation of the present study was based on the formula described by Pandis,[17] a significance level of .05, and a power of 80% to detect a difference of 2.6 mm ($\pm$2.8 mm) for the mandibular intermolar width between the cleft and control groups using the findings of Ye et al.[13] According to the results of the power analysis, 18 patients were needed for each group. Two authors simultaneously scanned the archive to determine the study samples according to the inclusion and exclusion criteria (cleft groups: complete UCLP or BCLP, surgically operated before the age of 3 years, and no other syndrome or congenital anomaly; normal occlusion group: Class I molar and canine relationship with normal overjet and overbite[18]; skeletally normal relationships of vertical and sagittal growth and development using the ANB, convexity, and SN-Go-Gn angles[19,20]; no presence of any cleft, syndrome, or congenital anomaly; and the patients in each group had all of their mandibular permanent teeth except third molars erupted, had no or minor crowding [less than 4 mm], and had no previous orthodontic, prosthodontic, or orthognathic surgery treatments). According to the above criteria, the study sample consisted of 75 patients divided into three groups: UCLP (29 patients; 8 females and 21 males; 8 right sided and 21 left sided; mean age: 15.40 $\pm$ 3.22 years), BCLP (18 patients; 7 females and 11 males; mean age: 15.54 $\pm$ 3.72 years), and normal occlusion (28 patients; 8 females and 20 males; mean age: 15.82 $\pm$ 2.11 years) groups. The control group was matched to the cleft groups according to chronological age and gender distribution as much as possible.

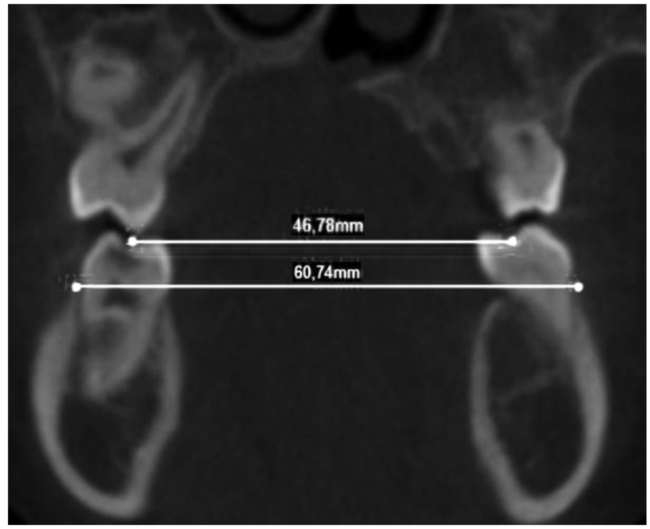

Figure 1. Mandibular intermolar dental and alveolar widths.

Images were obtained in a standard supine position using the same device (NewTom 5G, QR Verona, Italy) set at the following parameters: scanning time, 14–18 seconds; a limited field of view, 15 $\times$ 12 cm; exposure time, 3.6 seconds; and voxel size, 0.3 mm^3. The images were transformed to Digital Imaging and Communications in Medicine (DICOM) format, and then software (Simplant Software, Materialise, Leuven, Belgium) was used to perform the mandibular dental (intercanine and -molar), alveolar (intercanine and -molar), and skeletal (bigonial width) transversal measurements[21,22] (Figures 1–3), which were done at random by an experienced maxillofacial radiologist without knowing the group or sex of the patient.

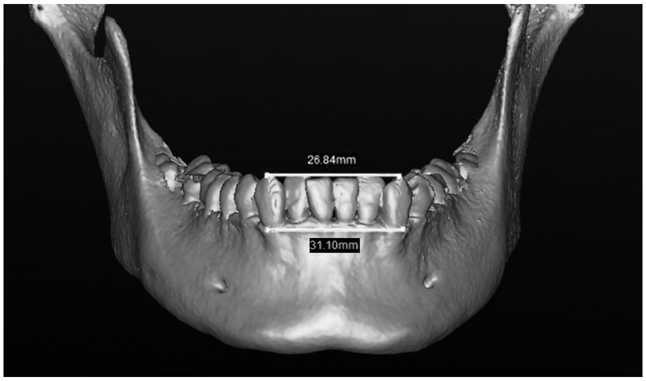

Figure 2. Mandibular intercanine dental and alveolar widths.

Statistical Analysis

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), 16.0 (SPSS for Windows, SPSS Inc, Chicago, Ill). After performing Shapiro-Wilks and Levene's variance homogeneity tests to test the normality of the data, statistical evaluations were performed using the parametric tests.

Descriptive data (mean and standard deviations) were calculated for all measurements. Mean values for chronological age and mandibular dental, alveolar, and skeletal transversal widths were compared using one-way variance analysis (ANOVA) and post hoc Tukey HSD tests. Gender distribution in each group was tested by Pearson's chi-square test. Comparison of the genders in each group and side of the cleft presence (right sided or left sided) in the UCLP group regarding the measurements was performed using the Mann-Whitney *U*-test. Statistical significance was set at $P < .05$.

To determine the error associated with CBCT measurements, 15 images were selected randomly. The measurements were repeated 4 weeks after the first examination by the same investigator without knowing the first measurements. Intraclass correlation coefficients were performed to assess the reliability of the measurements, as described by Houston.[23]

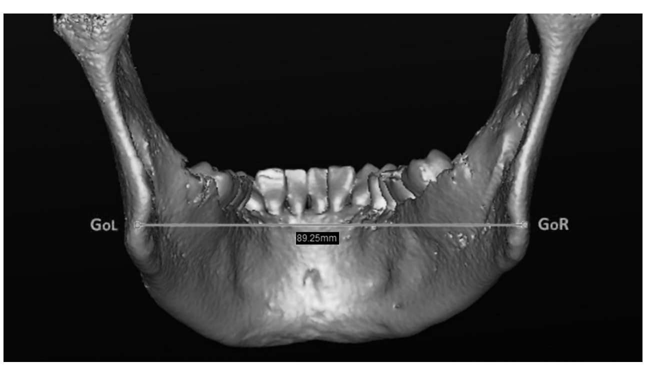

Figure 3. Mandibular bigonial width.

Table 2. Distribution of the Chronological Ages and Genders Among the Groups[a]

	Mean Age, y	Female/Male
UCLP group (n = 29)	15.40 ± 3.22	8/21
BCLP group (n = 18)	15.54 ± 3.72	7/11
Control group (n = 28)	15.82 ± 2.11	8/20
P	NS[b]	NS[c]

[a] UCLP indicates unilateral cleft lip and palate; BCLP, bilateral cleft lip and palate.
[b] Results of one-way analysis of variance test.
[c] Results of Pearson chi-square test.

RESULTS

The intraclass correlation coefficients for the measurements were greater than .971, confirming the measurement reliability.

Demographic values (chronological ages and gender distribution) of the groups are shown in Table 2. All groups were well matched on chronological age and gender distribution according to the results of the ANOVA and Pearson's chi-square tests, respectively ($P > .05$).

Table 3 shows the comparison of the mandibular dental, alveolar, and skeletal widths among the cleft and control groups. Statistical comparisons of the three groups showed no significant differences in mandibular intercanine and bigonial widths ($P > .05$); however, statistically significant differences were found for the mandibular intercanine alveolar, intermolar, and intermolar alveolar widths ($P < .001$). Patients affected by UCLP and BCLP had statistically significantly smaller intercanine alveolar widths ($P < .05$ and $P < .001$, respectively) and larger intermolar ($P < .001$ and $P < .05$, respectively) and intermolar alveolar widths ($P < .001$) compared with the normal occlusion group. Furthermore, the patients affected by UCLP and BCLP had similar mandibular dental, alveolar, and skeletal widths ($P > .05$).

DISCUSSION

In the present study, we aimed to evaluate the mandibular dental, alveolar, and skeletal transversal widths in patients affected by UCLP and BCLP and to compare the findings with well-matched normal occlusion samples by using the CBCT images retrospectively, which have not previously been reported in the literature. The cleft and control groups included in the study were statistically well matched on gender distribution and chronological ages. Mandibular dental, alveolar, and skeletal width measurements were similar for right- and left-side UCLP patients and for both genders; thus, the data were pooled for further statistical comparisons. In addition, the members of the study sample had all mandibular permanent teeth

Table 3. Comparisons of the Mandibular Transversal Widths Among the Groups[a]

	UCLP	BCLP	Control	P	Tukey HSD U-C	Tukey HSD B-C	Tukey HSD U-B
Intercanine width, mm	28.02 ± 2.09	26.96 ± 2.82	26.85 ± 2.33	.145			
Intercanine alveolar width, mm	35.66 ± 2.49	33.65 ± 4.64	37.87 ± 1.67	.000	.015	.000	.066
Intermolar width, mm	51.28 ± 3.69	49.86 ± 6.46	46.63 ± 2.37	.000	.000	.030	.491
Intermolar alveolar width, mm	62.38 ± 3.91	60.17 ± 8.09	56.66 ± 2.38	.000	.000	.047	.292
Bigonial width, mm	88.73 ± 6.27	85.12 ± 8.39	88.23 ± 4.14	.134			

[a] UCLP indicates unilateral cleft lip and palate; BCLP, bilateral cleft lip and palate; P, results of one-way analysis of variance test; U-C, comparison of UCLP and control groups; B-C, comparison of BCLP and control groups; U-B, comparison of UCLP and BCLP groups.

except third molars erupted, minor or no crowding, and no congenital anomaly in their mandibular arches. Therefore, crowding and congenital anomaly (tooth agenesis, supernumerary tooth, microdontia, and macrodontia) might not affect the results.

Few studies[15,16] previously investigated the mandibular skeletal transversal width using the frontal radiographs. Athanasiou et al.[16] studied the transverse dentofacial morphology of 64 children affected by isolated cleft palate at the ages of 3–4, 8–9, and 12 years and reported no difference in the bigonial width of the mandible between cleft and normal groups. However, in another study,[15] it was reported that the BCLP group presented significant differences in the dimensions of the bigonial width compared with the normal group. In the present study, the patients in each group had similar bigonial width values, showing that the type and presence of cleft did not affect the mandibular skeletal transverse width. The advantages of CBCT technique compared with the conventional radiographs were previously described in the literature[22,24–27]; CBCT technology makes it feasible to achieve true (1/1 size) images without magnification.

Maxillary dental and skeletal dimensions in cleft patients have been studied extensively, and a statistically significantly narrower maxillary arch was previously reported.[13,14,28] The information about the mandibular arch widths in cleft patients is limited, and the studies[10–14] concerning the mandibular arch dimensions were based only on plaster model measurements. According to Heidbuchel and Kuijpers-Jagtman,[14] a slight decrease in the anterior and posterior region of the mandibular arch was noticed as an adaptation to the maxillary arch in cleft patients aged 12 years. In addition, this finding was also reported by some authors[10–12] as an insignificant difference between cleft and normal patients at the ages of 3, 6, and 12 years using the patients' plaster models. In the present study, the patients affected by UCLP and BCLP had statistically significantly lower intercanine alveolar widths ($P < .05$ and $P < .001$, respectively) and larger intermolar ($P < .001$ and $P < .05$, respectively) and intermolar alveolar widths ($P < .001$) compared with the normal occlusion group. Our findings confirmed those of Ye et al.,[13] who reported that unoperated and operated UCLP patients had larger intermolar widths for the mandibular first and second molar teeth using CT scanning of the plaster models. The differences among the cleft and control groups might be due to the presence of clefts and/or the skeletal Class III malocclusions previously reported[3,5,9] to occur in cleft patients. According to Uysal et al.,[28] the mandibular and maxillary dental and alveolar width measurements in the Class III patients differed significantly from that of normal occlusion patients using the plaster models. In addition, the decrease in the mandibular intercanine width might be due to a narrow maxillary intercanine width, which causes adaptation of the mandibular intercanine width, and the increase in the mandibular intermolar width might be because of the lower tongue position in these patients due to the narrow scarred maxilla. On the other hand, future studies are needed to compare our finding of increased mandibular intermolar alveolar width because the present study is the first to use CBCT technology for the assessment of mandibular transversal widths of those patients affected by UCLP and BCLP.

The findings of our study showed statistically significant differences for mandibular dental and alveolar widths in patients affected by CLP regardless of its type, and thus, the preformed archwires, routinely used in orthodontic treatment, might not fit for cleft patients. Therefore, clinicians should be careful regarding the importance of using the increased individualized archwires according to the pretreatment arch width of the patients affected by CLP, as individualized archwires should be used for all orthodontic patients.

The weakness of the present study was that it included few patients in each group, although the study sample was calculated by means of power analyses, and the design of the study was retrospective but not prospective. Since it is not ethical to perform a prospective study by getting CBCT images for this kind of study, no patient was contacted or CBCT taken for the purpose of the present study. The strength of the study is the use of CBCT for an assessment that has not been previously done. However, further studies with larger study samples would also be welcome to compare our findings and will help clinicians plan treatment for these patients.

CONCLUSIONS

- Patients affected by UCLP and BCLP had statistically significantly smaller intercanine alveolar widths ($P < .05$ and $P < .001$, respectively) and larger intermolar ($P < .001$ and $P < .05$, respectively) and intermolar alveolar widths ($P < .001$) compared with the well-matched normal occlusion group.
- The patients affected by UCLP and BCLP had similar mandibular dental, alveolar, and skeletal widths ($P > .05$).

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